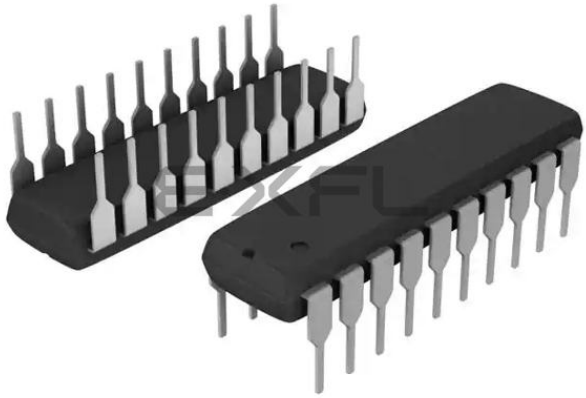

Welcome to E-XFL.COM

What is "Embedded - Microcontrollers"?

"Embedded - Microcontrollers" refer to small, integrated circuits designed to perform specific tasks within larger systems. These microcontrollers are essentially compact computers on a single chip, containing a processor core, memory, and programmable input/output peripherals. They are called "embedded" because they are embedded within electronic devices to control various functions, rather than serving as standalone computers. Microcontrollers are crucial in modern electronics, providing the intelligence and control needed for a wide range of applications.

Applications of "Embedded - Microcontrollers"

Details	
Product Status	Discontinued at Digi-Key
Core Processor	eZ8
Core Size	8-Bit
Speed	20MHz
Connectivity	I²C, IrDA, UART/USART
Peripherals	Brown-out Detect/Reset, POR, PWM, WDT
Number of I/O	11
Program Memory Size	8KB (8K x 8)
Program Memory Type	FLASH
EEPROM Size	-
RAM Size	1K x 8
Voltage - Supply (Vcc/Vdd)	2.7V ~ 3.6V
Data Converters	A/D 2x10b
Oscillator Type	Internal
Operating Temperature	-40°C ~ 105°C (TA)
Mounting Type	Through Hole
Package / Case	20-DIP (0.300", 7.62mm)
Supplier Device Package	-
Purchase URL	https://www.e-xfl.com/product-detail/zilog/z8f0821ph020ec

Warning: DO NOT USE IN LIFE SUPPORT

LIFE SUPPORT POLICY

ZILOG'S PRODUCTS ARE NOT AUTHORIZED FOR USE AS CRITICAL COMPONENTS IN LIFE SUPPORT DEVICES OR SYSTEMS WITHOUT THE EXPRESS PRIOR WRITTEN APPROVAL OF THE PRESIDENT AND GENERAL COUNSEL OF ZILOG CORPORATION.

As used herein

Life support devices or systems are devices which (a) are intended for surgical implant into the body, or (b) support or sustain life and whose failure to perform when properly used in accordance with instructions for use provided in the labeling can be reasonably expected to result in a significant injury to the user. A critical component is any component in a life support device or system whose failure to perform can be reasonably expected to cause the failure of the life support device or system or to affect its safety or effectiveness.

Document Disclaimer

 Information in this publication concerning the devices, applications, or technology described is intended to suggest possible uses and may be superseded. ZILOG, INC. DOES NOT ASSUME LIABILITY FOR OR PROVIDE A REPRESENTATION OF ACCURACY OF THE INFORMATION, DEVICES, OR TECHNOLOGY DESCRIBED IN THIS DOCUMENT. ZILOG ALSO DOES NOT ASSUME LIABILITY FOR INTELLECTUAL PROPERTY INFRINGEMENT RELATED IN ANY MANNER TO USE OF INFORMATION, DEVICES, OR TECHNOLOGY DESCRIBED HEREIN OR OTHERWISE. The information contained within this document has been verified according to the general principles of electrical and mechanical engineering.

Table of Contents

Block Diagram

Figure 1 displays the block diagram of the architecture of Z8 Encore! XP® F0822 Series devices.

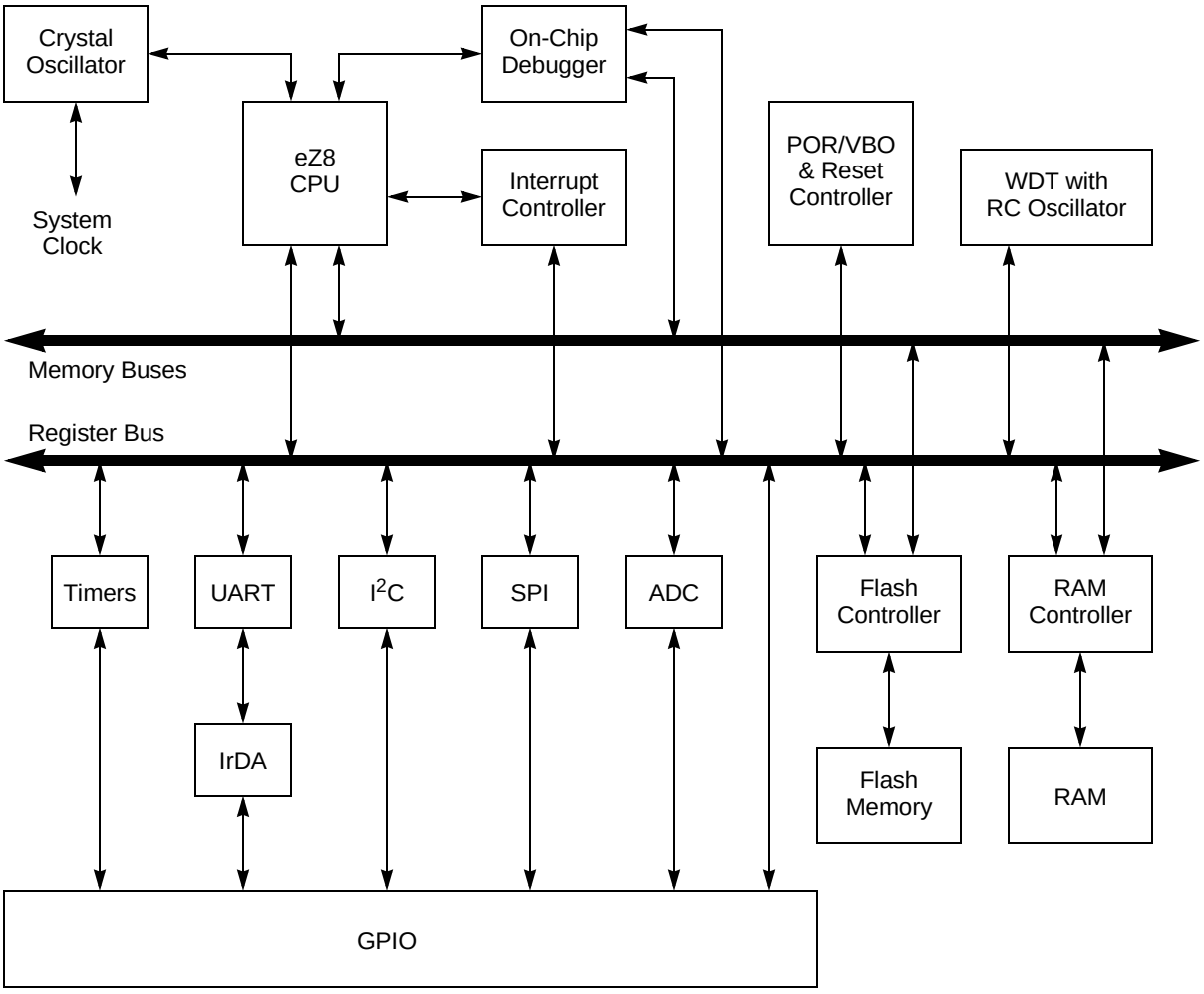

Figure 1. Z8 Encore! XP® F0822 Series Block Diagram

CPU and Peripheral Overview

eZ8 CPU Features

Zilog's latest eZ8 8-bit CPU, meets the continuing demand for faster and more code-efficient microcontrollers. The eZ8 CPU executes a superset of the original Z8® instruction set.

Timer 1 Reload Low Byte
T1RL (F0BH - Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0

Timer 1 reload value [7:0]

Timer 1 PWM High Byte
T1PWMH (F0CH - Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0

Timer 1 PWM value [15:8]

Timer 1 PWM Low Byte
T1PWML (F0DH - Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0

Timer 1 PWM value [7:0]

Timer 1 Control 0
T1CTL0 (F0EH - Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0

Reserved
Cascade Timer
0 = Timer 1 Input signal is GPIO pin
1 = Timer 1 Input signal is Timer 0 out
Reserved

Timer 1 Control 1
T1CTL1 (F0FH - Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0

Timer Mode
000 = One-Shot mode
001 = Continuous mode
010 = Counter mode
011 = PWM mode
100 = Capture mode
101 = Compare mode
110 = Gated mode
111 = Capture/Compare mode
Prescale Value
000 = Divide by 1
001 = Divide by 2
010 = Divide by 4
011 = Divide by 8
100 = Divide by 16
101 = Divide by 32
110 = Divide by 64
111 = Divide by 128
Timer Input/Output Polarity
Operation of this bit is a function of the current operating mode of the timer
Timer Enable
0 = Timer is disabled
1 = Timer is enabled

UART0 Transmit Data
U0TXD (F40H - Write Only)

D7	D6	D5	D4	D3	D2	D1	D0

UART0 transmitter data byte

UART0 Receive Data
U0RXD (F40H - Read Only)

D7	D6	D5	D4	D3	D2	D1	D0

UART0 receiver data byte

ADC Control
ADCCTL (F70H - Read/Write)

D7	D6	D5	D4	D3	D2	D1	D0

- D0: Analog Input Select
  0000 = ANA0 0001 = ANA1
  0010 = ANA2 0011 = ANA3
  0100 = ANA4
  0101 through 21111 = Reserved
- D4: Continuous Mode Select
  0 = Single-shot conversion
  1 = Continuous conversion
- D5: External VREF select
  0 = Internal voltage reference selected
  1 = External voltage reference selected
- D6: Reserved
- D7: Conversion Enable
  0 = Conversion is complete
  1 = Begin conversion

ADC Data High Byte
ADCD_H (F72H - Read Only)

D7	D6	D5	D4	D3	D2	D1	D0

- D0: ADC Data [9:2]

ADC Data Low Bits
ADCD_L (F73H - Read Only)

D7	D6	D5	D4	D3	D2	D1	D0

- D2: Reserved
- D6: ADC Data [1:0]

Stop Mode Recovery Using WDT Time-Out

If the WDT times out during STOP mode, the device undergoes a Stop Mode Recovery sequence. In the WDT Control Register, the WDT and STOP bits are set to 1. If the WDT is configured to generate an interrupt upon time-out and the Z8 Encore! XP® F0822 Series device is configured to respond to interrupts, the eZ8 CPU services the WDT interrupt request following the normal Stop Mode Recovery sequence.

Stop Mode Recovery Using a GPIO Port Pin Transition

Each of the GPIO Port pins can be configured as a Stop Mode Recovery input source. On any GPIO pin enabled as a STOP Mode Recover source, a change in the input pin value (from High to Low or from Low to High) initiates Stop Mode Recovery. The GPIO Stop Mode Recovery signals are filtered to reject pulses less than 10 ns (typical) in duration. In the WDT Control Register, the STOP bit is set to 1.

Caution: *In STOP mode, the GPIO Port Input Data Registers (PxIN) are disabled. The Port Input Data Registers record the Port transition only if the signal stays on the Port pin through the end of the Stop Mode Recovery delay. Therefore, short pulses on the Port pin initiates Stop Mode Recovery without being written to the Port Input Data Register or without initiating an interrupt (if enabled for that pin).*

Port A–C Control Registers

The Port A–C Control Registers set the GPIO port operation. The value in the corresponding Port A–C Address Register determines the control sub-registers accessible using the Port A–C Control Register (Table 15).

Table 15. Port A–C Control Registers (P*x*CTL)

BITS	7	6	5	4	3	2	1	0
FIELD	PCTL							
RESET	00H							
R/W	R/W							
ADDR	FD1H, FD5H, FD9H							

PCTL[7:0]—Port Control
The Port Control Register provides access to all sub-registers that configure the GPIO Port operation.

Port A–C Data Direction Sub-Registers

The Port A–C Data Direction sub-register is accessed through the Port A–C Control register by writing 01H to the Port A–C Address Register (Table 16).

Table 16. Port A–C Data Direction Sub-Registers

BITS	7	6	5	4	3	2	1	0
FIELD	DD7	DD6	DD5	DD4	DD3	DD2	DD1	DD0
RESET	1							
R/W	R/W							
ADDR	If 01H in Port A–C Address Register, accessible through the Port A–C Control Register							

DD[7:0]—Data Direction

These bits control the direction of the associated port pin. Port Alternate Function operation overrides the Data Direction register setting.
0 = Output. Data in the Port A–C Output Data Register is driven onto the port pin.
1 = Input. The port pin is sampled and the value written into the Port A–C Input Data Register. The output driver is tri-stated.

Port A–C Alternate Function Sub-Registers

The Port A–C Alternate Function sub-register (Table 17) is accessed through the Port A–C Control Register by writing 02H to the Port A–C Address Register. The Port A–C Alternate Function sub-registers select the alternate functions for the selected

Table 43. Timer 0–1 PWM High Byte Register (TxPWMH)

BITS	7	6	5	4	3	2	1	0
FIELD	PWMH							
RESET	0							
R/W	R/W							
ADDR	F04H, F0CH							

Table 44. Timer 0–1 PWM Low Byte Register (TxPWML)

BITS	7	6	5	4	3	2	1	0
FIELD	PWML							
RESET	0							
R/W	R/W							
ADDR	F05H, F0DH							

PWMH and PWML—Pulse-Width Modulator High and Low Bytes
These two bytes, {PWMH[7:0], PWML[7:0]}, form a 16-bit value that is compared to the current 16-bit timer count. When a match occurs, the PWM output changes state. The PWM output value is set by the TPOL bit in the Timer Control Register (TxCTL) register.

The TxPWMH and TxPWML registers also store the 16-bit captured timer value when operating in CAPTURE or CAPTURE/COMPARE modes.

Timer 0–3 Control 0 Registers

The Timer 0–3 Control 0 (TxCTL0) registers (Table 45) allow cascading of the Timers.

Table 45. Timer 0–3 Control 0 Register (TxCTL0)

BITS	7	6	5	4	3	2	1	0
FIELD	Reserved			CSC	Reserved			
RESET	0							
R/W	R/W							
ADDR	F06H, F0EH, F16H, F1EH							

CSC—Cascade Timers
0 = Timer Input signal comes from the pin.
1 = For Timer 0, input signal is connected to Timer 1 output.
For Timer 1, input signal is connected to Timer 0 output.

Timer 0–1 Control 1 Registers

The Timer 0–1 Control (TxCTL) registers enable/disable the timers, set the prescaler value, and determine the timer operating mode.

Table 46. Timer 0–1 Control Register (TxCTL)

BITS	7	6	5	4	3	2	1	0
FIELD	TEN	TPOL	PRES			TMODE		
RESET	0							
R/W	R/W							
ADDR	F07H, F0FH							

TEN—Timer Enable
0 = Timer is disabled.
1 = Timer enabled to count.

TPOL—Timer Input/Output Polarity
Operation of this bit is a function of the current operating mode of the timer.

ONE-SHOT Mode
When the timer is disabled, the Timer Output signal is set to the value of this bit. When the timer is enabled, the Timer Output signal is complemented upon timer Reload.

CONTINUOUS Mode
When the timer is disabled, the Timer Output signal is set to the value of this bit. When the timer is enabled, the Timer Output signal is complemented upon timer Reload.

COUNTER Mode
If the timer is enabled the Timer Output signal is complemented after timer reload.
0 = Count occurs on the rising edge of the Timer Input signal.
1 = Count occurs on the falling edge of the Timer Input signal.

PWM Mode
0 = Timer Output is forced Low (0) when the timer is disabled. When enabled, the Timer Output is forced High (1) upon PWM count match and forced Low (0) upon Reload.
1 = Timer Output is forced High (1) when the timer is disabled. When enabled, the Timer Output is forced Low (0) upon PWM count match and forced High (1) upon Reload.

CAPTURE Mode
0 = Count is captured on the rising edge of the Timer Input signal.
1 = Count is captured on the falling edge of the Timer Input signal.

Clear To Send Operation

The CTS pin, if enabled by the CTSE bit of the UART Control 0 register, performs flow control on the outgoing transmit datastream. The Clear To Send ($\overline{CTS}$) input pin is sampled one system clock before beginning any new character transmission. To delay transmission of the next data character, an external receiver must deassert $\overline{CTS}$ at least one system clock cycle before a new data transmission begins. For multiple character transmissions, this would be done during STOP bit transmission. If $\overline{CTS}$ deasserts in the middle of a character transmission, the current character is sent completely.

Multiprocessor (9-bit) Mode

The UART has a MULTIPROCESSOR (9-bit) mode that uses an extra (9th) bit for selective communication when a number of processors share a common UART bus. In MULTIPROCESSOR mode (also referred to as 9-bit mode), the multiprocessor bit is transmitted following the 8-bits of data and immediately preceding the STOP bit(s) as displayed in Figure 14. The character format is as displayed in Figure 14.

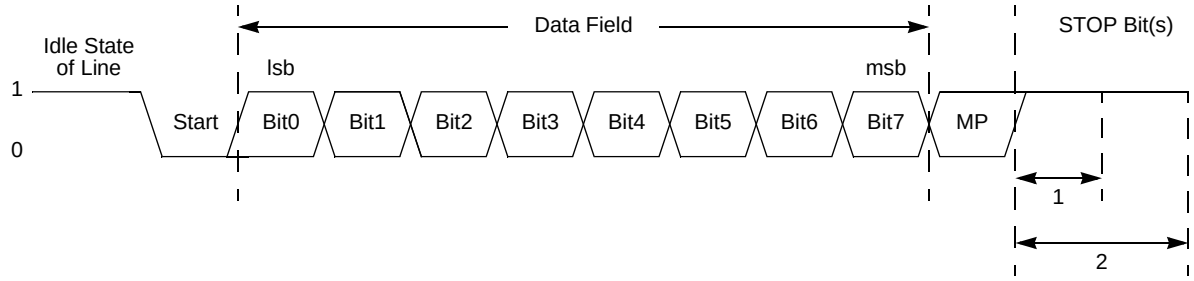

Figure 14. UART Asynchronous MULTIPROCESSOR Mode Data Format

In MULTIPROCESSOR (9-bit) mode, the Parity bit location (9th bit) becomes the Multiprocessor control bit. The UART Control 1 and Status 1 Registers provide Multiprocessor (9-bit) mode control and status information. If an automatic address matching scheme is enabled, the UART Address Compare Register holds the network address of the device.

MULTIPROCESSOR (9-bit) Mode Receive Interrupts

When multiprocessor mode is enabled, the UART only processes frames addressed to it. The determination of whether a frame of data is addressed to the UART can be made in hardware, software, or combination of the two depending on the multiprocessor configuration bits. In general, the address compare feature reduces the load on the CPU, because it does not need to access the UART when it receives data directed to other devices on the

SPI Mode Register

The SPI Mode Register configures the character bit width and the direction and value of the $\overline{SS}$ pin.

Table 66. SPI Mode Register (SPIMODE)

BITS	7	6	5	4	3	2	1	0
FIELD	Reserved		DIAG	NUMBITS[2:0]			SSIO	SSV
RESET	0							
R/W	R		R/W					
ADDR	F63H							

Reserved—Must be 0

DIAG–Diagnostic Mode Control bit
This bit is for SPI diagnostics. Setting this bit allows the BRG value to be read using the SPIBRH and SPIBRL Register locations.
0 = Reading SPIBRH, SPIBRL returns the value in the SPIBRH and SPIBRL Registers
1 = Reading SPIBRH returns bits [15:8] of the SPI Baud Rate Generator; and reading SPIBRL returns bits [7:0] of the SPI Baud Rate Counter. The Baud Rate Counter High and Low byte values are not buffered.

Caution: *Take precautions if you are reading the values while BRG is counting.*

NUMBITS[2:0]—Number of Data Bits Per Character to Transfer
This field contains the number of bits to shift for each character transfer. See the SPI Data Register description for information on valid bit positions when the character length is less than 8-bits.
000 = 8 bits
001 = 1 bit
010 = 2 bits
011 = 3 bits
100 = 4 bits
101 = 5 bits
110 = 6 bits
111 = 7 bits

SSIO—Slave Select I/O
0 = $\overline{SS}$ pin configured as an input.
1 = $\overline{SS}$ pin configured as an output (MASTER mode only).

SSV—Slave Select Value
If SSIO = 1 and SPI configured as a Master:
0 = $\overline{SS}$ pin driven Low (0).

BRH = SPI Baud Rate High Byte
Most significant byte, BRG[15:8], of the SPI Baud Rate Generator's reload value.

Table 69. SPI Baud Rate Low Byte Register (SPIBRL)

BITS	7	6	5	4	3	2	1	0
FIELD	BRL							
RESET	1							
R/W	R/W							
ADDR	F67H							

BRL = SPI Baud Rate Low Byte
Least significant byte, BRG[7:0], of the SPI Baud Rate Generator's reload value.

ADCD_L—ADC Data Low Bits
These are the least significant two bits of the 10-bit ADC output. These bits are undefined after a Reset.

Reserved
These bits are reserved and are always undefined.

On-Chip Oscillator

Z8 Encore! XP® F0822 Series products feature an on-chip oscillator for use with external crystals with frequencies from 32 kHz to 20 MHz. In addition, the oscillator can support external RC networks with oscillation frequencies up to 4 MHz or ceramic resonators with oscillation frequencies up to 20 MHz. This oscillator generates the primary system clock for the internal eZ8 CPU and the majority of the on-chip peripherals. Alternatively, the X_{IN} input pin can also accept a CMOS-level clock input signal (32 kHz–20 MHz). If an external clock generator is used, the X_{OUT} pin must be left unconnected.

When configured for use with crystal oscillators or external clock drivers, the frequency of the signal on the X_{IN} input pin determines the frequency of the system clock (that is, no internal clock divider). In RC operation, the system clock is driven by a clock divider (divide by 2) to ensure 50% duty cycle.

Operating Modes

Z8 Encore! XP F0822 Series products support 4 different oscillator modes:

- On-chip oscillator configured for use with external RC networks (<4 MHz).
- Minimum power for use with very low frequency crystals (32 kHz to 1.0 MHz).
- Medium power for use with medium frequency crystals or ceramic resonators (0.5 MHz to 10.0 MHz).
- Maximum power for use with high frequency crystals or ceramic resonators (8.0 MHz to 20.0 MHz).

The oscillator mode is selected through user-programmable Option Bits. For more information, see Option Bits on page 163.

Crystal Oscillator Operation

Figure 34 on page 168 displays a recommended configuration for connection with an external fundamental-mode, parallel-resonant crystal operating at 20 MHz. Recommended 20 MHz crystal specifications are provided in Table 91 on page 168. Resistor R1 is optional and limits total power dissipation by the crystal. The printed circuit board layout must add no more than 4 pF of stray capacitance to either the X_{IN} or X_{OUT} pins. If oscillation does not occur, reduce the values of capacitors C1 and C2 to decrease loading.

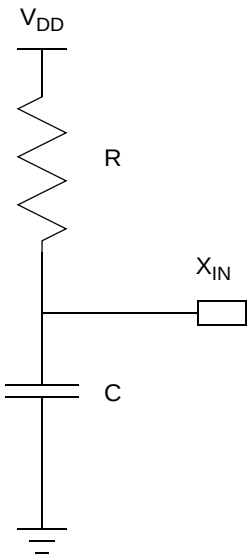

Figure 35. Connecting the On-Chip Oscillator to an External RC Network

An external resistance value of 45 kΩ is recommended for oscillator operation with an external RC network. The minimum resistance value to ensure operation is 40 kΩ. The typical oscillator frequency can be estimated from the values of the resistor (*R* in kΩ) and capacitor (*C* in pF) elements using the below equation:

$$\text{Oscillator Frequency (kHz)} = \frac{1\times10^{6}}{(0.4 \times R \times C) + (4 \times C)}$$

Figure 36 on page 170 displays the typical (3.3 V and 25 ^{0}C) oscillator frequency as a function of the capacitor (*C* in pF) employed in the RC network assuming a 45 kΩ external resistor. For very small values of C, the parasitic capacitance of the oscillator XIN pin and the printed circuit board should be included in the estimation of the oscillator frequency.

It is possible to operate the RC oscillator using only the parasitic capacitance of the package and printed circuit board. To minimize sensitivity to external parasites, external capacitance values in excess of 20 pF are recommended.

AC Characteristics

Table 98 provides information on the AC characteristics and timing. All AC timing information assumes a standard load of 50 pF on all outputs.

Table 98. AC Characteristics

Symbol	Parameter	V_{DD} = 2.7 - 3.6 V T_A = -40 °C to 105 °C		Units	Conditions
		Minimum	Maximum		
F_{SYSCLK}	System Clock Frequency (ROM)	–	20.0	MHz	
F_{SYSCLK}	System Clock Frequency (Flash)	–	20.0	MHz	Read-only from Flash memory.
		0.032768	20.0	MHz	Program or erasure of the Flash memory.
F_{XTAL}	Crystal Oscillator Frequency	0.032768	20.0	MHz	System clock frequencies below the crystal oscillator minimum require an external clock driver.
T_{XIN}	System Clock Period	50	–	ns	$T_{CLK} = 1/F_{sysclk}$
T_{XINH}	System Clock High Time	20	30	ns	T_{CLK} = 50 ns
T_{XINL}	System Clock Low Time	20	30	ns	T_{CLK} = 50 ns

Table 126. eZ8 CPU Instruction Summary (Continued)

Assembly Mnemonic	Symbolic Operation	Address Mode dst	Address Mode src	Opcode(s) (Hex)	Flags C	Z	S	V	D	H	Fetch Cycles	Instr. Cycles
LDX dst, src	dst ← src	r	ER	84	-	-	-	-	-	-	3	2
		Ir	ER	85							3	3
		R	IRR	86							3	4
		IR	IRR	87							3	5
		r	X(rr)	88							3	4
		X(rr)	r	89							3	4
		ER	r	94							3	2
		ER	Ir	95							3	3
		IRR	R	96							3	4
		IRR	IR	97							3	5
		ER	ER	E8							4	2
		ER	IM	E9							4	2
LEA dst, X(src)	dst ← src + X	r	X(r)	98	-	-	-	-	-	-	3	3
		rr	X(rr)	99							3	5
MULT dst	dst[15:0] ← dst[15:8] * dst[7:0]	RR		F4	-	-	-	-	-	-	2	8
NOP	No operation			0F	-	-	-	-	-	-	1	2
OR dst, src	dst ← dst OR src	r	r	42	-	*	*	0	-	-	2	3
		r	Ir	43							2	4
		R	R	44							3	3
		R	IR	45							3	4
		R	IM	46							3	3
		IR	IM	47							3	4
ORX dst, src	dst ← dst OR src	ER	ER	48	-	*	*	0	-	-	4	3
		ER	IM	49							4	3
POP dst	dst ← @SP SP ← SP + 1	R		50	-	-	-	-	-	-	2	2
		IR		51							2	3

Part Number	Flash	RAM	I/O Lines	Interrupts	16-Bit Timers w/PWM	10-Bit A/D Channels	I^2C	SPI	UARTs with IrDA	Description
Z8F04xx with 4 KB Flash										
Standard Temperature: 0 °C to 70 °C										
Z8F0411HH020SC	4 KB	1 KB	11	16	2	0	1	0	1	SSOP 20-pin package
Z8F0411PH020SC	4 KB	1 KB	11	16	2	0	1	0	1	PDIP 20-pin package
Z8F0412SJ020SC	4 KB	1 KB	19	19	2	0	1	1	1	SOIC 28-pin package
Z8F0412PJ020SC	4 KB	1 KB	19	19	2	0	1	1	1	PDIP 28-pin package
Extended Temperature: -40 °C to 105 °C										
Z8F0411HH020EC	4 KB	1 KB	11	16	2	0	1	0	1	SSOP 20-pin package
Z8F0411PH020EC	4 KB	1 KB	11	16	2	0	1	0	1	PDIP 20-pin package
Z8F0412SJ020EC	4 KB	1 KB	19	19	2	0	1	1	1	SOIC 28-pin package
Z8F0412PJ020EC	4 KB	1 KB	19	19	2	0	1	1	1	PDIP 28-pin package
Z8F08200100KITG										Development Kit (20- and 28-pin)
ZUSBSC00100ZACG										USB Smart Cable Accessory Kit
ZUSBOPTSC01ZACG										Opto-Isolated USB Smart Cable Accessory Kit

Note: Replace C with G for lead-free packaging.

R

X

Z